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ABSTRACT

The kinds of questions asked about the incorporation of computers into the classroom's social environment will largely dictate the methods of answering them. Asking about the effects of technology and the social life of classrooms is problematic, however. For example, traditional two-group, experimental studies are flawed because computers per se do not constitute a treatment, the treatment would not be uniform, and the effects may not be observable except over time. An alternate view would consider the classroom as the social context. Questions would then concern the places and processes of change that may accompany the use of the technology. The critical elements of the incorporation process include teachers' interpretation of the purposes of software, whether computer-based work is a legitimate part of the learning agenda, the interactional changes in the classroom that the technology can support, and whether these changes are viewed as legitimate. Computers offer the option of rethinking the selection of learning agendas, the design of curricula, and the ways in which learning tasks are done in classrooms. Thirteen references are listed. (LMM)

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## "I'm the thinkist, you're the typist": The Interaction of Technology and the Social Life of Classrooms

Karen Sheingold, Jan Hawkins, and
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# "I'M THE THINKIST, YOU'RE THE TYPIST": THE INTERACTION OF TECHNOLOGY AND THE SOCIAL LIFE OF CLASSROOMS*,**

Karen Sheingold, Jan Hawkins, and Cynthia Char

## Introduction

Research on technology and the social life of classrooms is in its infancy. It is only since microcomputers became widely available some five years ago that it has made sense to ask about what microcomputers might mean for students and teachers in classrooms. Now, with several hundred thousand computers in schools and the number growing rapidly (Becker, 1982), it is urgent to do so. Just as pressing, however, is the need to reflect on what kinds of questions we ask about computers and the social life of classrooms, and how we go about answering them. In what follows, we propose a framework for understanding the interaction of computers with the social life of classrooms, and illustrate this framework with examples from several studies we have conducted over the last four years.

Questions and methods. The kinds of questions we ask about the incorporation of computers into the social environment of classrooms will, to a large extent, dictate our methods for answering them. Three years ago, as part of a program of research, we wanted to know about some of the "social effects" of computers in classrooms. The question about effects implied an experimental approach, which we adopted. Having introduced computers for programming work (the "treatment") into two classrooms, we compared students when they were using computers and when they were doing other classroom work, both early and late in the school year (Hawkins, Sheingold,

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Gearhart, & Berger, 1982). Comparison of these patterns allowed us to say some things about the effects of the technology on different kinds of learning interactions in these particular classrooms. But this type of study alone was not sufficient to reveal the impact of the technology on the life of classrooms. In order to interpret what happened, it was also necessary to collect information about the day-to-day process of working with the technology, and the meaning it had to members of the classroom (Hawkins, 1984b).

Asking about technology and the social life of classrooms in terms of effects, with its implications for how we do research, is problematic for several reasons. To illustrate this point, let us do an imaginary "computer treatment" study. In order to determine the social effects of using computers in classrooms, we first measure social variables of interest in two comparable groups of classrooms, then give computers to one of these groups. We go back and measure these variables again when the computer treatment ends, some few weeks or months later. Differences between the experimental and control groups before and after the treatment tell us clearly what the effects are. Or do they?

Our imaginary study about computers in classrooms is flawed in three critical ways. First, computers per se do not constitute a treatment. One of the most interesting and, for education, most challenging characteristics of the computer is that it is not a device that can be used in only one way to achieve one end--it is many devices that can be used in multiple ways to achieve varied ends (Sheingold, 1983). While the most common computer uses today are drill and practice and programming (Becker, 1982), the range of uses also includes tutorials, simulations, and tools (e.g., word processing and database management). Each of these uses may have different ways of fitting into and shaping the work of the classroom, as well as the patterns of social interaction surrounding that work. For example, while drill and practice is generally an activity for an individual child interacting with the computer, programming and word processing afford opportunities for collaboration among students--a form of interaction unusual in most classrooms. We need to ask about particular uses of the technology in order to begin to understand its relation to the social life of classrooms.

Second, even if we do study only one use of the computer--let's say, programming--the treatment will not be uniform. With the possible exception of drill and practice and the tutorial functions of the computer, most computer uses are flexible. They are open to multiple interpretations and many different approaches and uses in the classroom. To give but one example, a teacher who introduces her students to Logo in the classroom as a way of "helping students know

how computers work" may do very different things from one who introduces Logo for the purpose of teaching students specific programming concepts. In the first case, the work is likely to be loosely structured, with the teacher's role one of helping the students to use the computers for any Logo-based activity of interest to them. In the second, the work is likely to be structured around the particular concepts the teacher deems important, with the teacher taking an active role to ensure that those particular concepts are learned and used.

One way to deal with this methodological problem of noncomparable treatments is to train teachers to do exactly the same thing in exactly the same way in their classrooms, so we can then get a clear notion of the social effects thus generated. But to take this approach will be to engineer out of our research what may be its most important social aspect --namely, the ways in which teachers naturally interpret, work with, and shape this new technology.

The third and final problem with our study is the assumption that the question about social effects can be answered in a reasonable period of time--a few weeks or months--by a method which looks only at time 1 (before the treatment) and time 2 (after the treatment). This snapshot approach to measurement assumes that the effects of computers in classrooms will be clearly observable in a short period of time--that whatever was going to happen will happen quickly. Moreover, it also assumes that comparison of the same measures for times 1 and 2 will provide sufficient contextual information for interpreting observed differences.

Precisely because the computer is a flexible, interpretable device, the processes of interpreting and reinterpreting it, of adapting to it, and adapting it to the purposes of the classroom are likely to take a long time. Within a few weeks or months, no real end point will be reached, except in the case of the teacher who decides to abandon the machine altogether. And it is only by looking carefully at what happened between times 1 and 2 that we can gain insight into how this new technology is being shaped by or is facilitating changes in the social life of the classroom.

An alternate view. Rather than starting with a question about effects and its accompanying computer treatment study, let us start instead with the classroom as the social context we are examining. The questions then concern the places and processes of change which may accompany the use of the technology. We need better to understand where to look in the vast territory of social expectations and behavior that is part of classroom life. This genre of question is certainly not new. It has been repeatedly demonstrated that understanding of any

performance must be embedded in the practices of the particular work setting--crossculturally (Cole, Gay, Glick, & Sharp, 1971), in classrooms (Cole, Hood, & McDermott, 1981), and specifically with respect to children's computer programming efforts (Pea, 1984). Since computers are a new and powerful innovation, the processes of their assimilation into classroom practices require careful attention.

Classrooms are well-established cultures, with social organizations and work-related agendas embodied in long-standing curricula. The core subjects to be emphasized, and the types of activity to be conducted, are features of the formal learning setting constructed over many years. Teachers, students, and parents share well-developed expectations about formal learning settings in terms of what is valued, what is taught and learned, and how the work is organized socially.

Microcomputers enter the social context of the classroom and, in so doing, raise questions for teachers who wish to incorporate the technology effectively. What are computers and different kinds of software good for? How does the hardware fit into the organization of classroom social and physical space? What can students learn from computer-based experiences? What should students be accountable for learning? How does the technology and the learning it affords relate to traditional curricular areas and traditional classroom modes of learning?

The teachers' answers to these questions--their interpretations of this new technology--will play a central role in how and whether the technology becomes an integral part of the classroom. The technology itself is rich in possibilities for new learning activities and interactions in the classroom. These may or may not be realized. And new activities and forms of classroom organization may well be created by the teachers themselves as they interact with, adapt to, and shape the technology to their own purposes.

This interactive process--between classrooms and particular software-based activities--will happen over a long period of time, with different outcomes depending on factors not yet clearly identified. A research approach which attempts to shed light on this process will, at this stage of our knowledge, necessarily entail long-term classroom observation and talking to teachers.

In the remainder of this paper, we will illustrate this framework by further developing what we see as critical elements of the process by which computers are incorporated into the social life of the classroom. First, we will consider the teacher's interpretation of what software is for and whether computer-based work is a legitimate part of the learning agenda. Second, we will discuss the interactional changes in

the classroom that the technology can support, and whether these learning forms are viewed as legitimate.

## The Meaning of Software

Standard curriculum subject areas form the boundary conditions for the ways in which learning tasks take place in classrooms: "I learn these kinds of things for science, and these kinds of facts for social studies." This conceptual structure helps everybody to proceed through the school's yearly cycle and accomplish the learning that has been defined as a year's work. The standard divisions are very resistant to change. For example, many people experience both conceptual and administrative difficulty in trying to do interdisciplinary work.

Many of the more innovative uses of the technology, however, do not slide neatly into standard curricular niches. Tool software (word processors, database management systems), simulations, or programming environments such as Logo, just now making their way into classrooms, can directly or indirectly challenge what is taught and how it is taught. Each of these types of software must be interpreted and shaped by the individual teacher. We have observed across a number of different classrooms how the same type of software, or even a single piece of software, can be presented through a variety of educational approaches to meet different educational objectives.

Teachers' interpretations. In one project, researchers examined database management systems (dbms) and their educational potential for schools. Since this type of tool software can allow users to flexibly organize, record, store, retrieve, and query bodies of information, we were interested in whether using such software could help students understand and master important information management and research skills.

In one of the studies (Freeman, Hawkins, & Char, 1984). researchers visited eight different schools where teachers were in the early stages of incorporating dbms into their classroom curricula. We observed the dbms activities embedded in different subjects across classrooms. These activities varied along a continuum from minimal to increasingly greater integration with ongoing, core classroom curricula.

At one end of the continuum, a personal computing teacher viewed dbms as an integral part of the business world. She wished to expose her students to the ways computers are used in business, and thus had them design a payroll program. Other teachers also focused on the record-keeping function and format characteristics of the dbms, yet went beyond the business context and adapted assignments

to students' interests. For example, one teacher had students construct a personal interest file, with such entries as their favorite television show or food. However, once entered, the information was sorted according to traditional business divisions, such as alphabetically by name or chronologically by birthdate. A sorting function which would have allowed students to learn something new about the preference patterns among classmates was neither considered nor used. Furthermore, the records were still detached from and unrelated to anything in the regular curriculum; the dbms were presented in the isolated context of "computer literacy," as an example of how computers are used.

In contrast, one junior high school teacher viewed the dbms as software that could encourage students to think critically and deal with general concepts of information organization. In a law course, he had students read famous legal cases, take notes on the cases in ways which made sense to them individually, and then design a format for entering the information into a database system. This required students to build an organizational structure that could hold the key information about each case they had read. They then had to search for general categories which could be applied to all of the cases, and then defend those information constructs. Finally, students were encouraged to use the database to draw new inferences from the materials, and to analyze and synthesize the information in different ways. As expressed by this teacher:

> They need to recognize that when dealing with information, there is not one right answer; that the process is not linear but schematic....The research process is hard. Developing probing questions and manipulating information is not easy for them. The database is a simple way to organize data...it requires them to pose questions and to be thoughtful about what they want to know.

Thus, in the above classrooms, we observed fundamentally different ways of viewing and then using the same type of software. Some students were learning that "this is how computers are used in the world," while others were exposed to new and challenging ways to think about and conduct social studies research.

In another project, we have been developing and studying other types of software such as data gathering and graphing software, computer models, and simulations. All of this software is intended to help upper elementary children learn more about science and mathematics. In a classroom fieldtest of these materials (Char, Hawkins, Wootten, Sheingold, & Roberts, 1983), we noted that teachers' perceptions of science, mathematics, and computers proved to be a

critical factor in shaping the interpretation and presentation of a single piece of software.

A navigation simulation, Rescue Mission, was designed to motivate students to apply geometric principles to the real-world problem of ocean navigation. The simulation's premise is that a whale is trapped in a fishing trawler's net and that students, as crew members on different ships, are summoned to free the whale. Students receive a radio distress call, use simulated navigational instruments such as radar, radio direction finder, and binoculars, and can motor their ship to reach the trawler. Thus, the simulation is intended to provide children with an appealing and functional learning context for mathematical concepts such as grid coordinates, degrees, angles, vectors, triangulation, and speed/time/distance relationships. These concepts are typically presented to students as individual mathematics problems on worksheets, devoid of context.

As with our research on database management systems, the fieldtest revealed multiple interpretations of the software. For some teachers, the simulation was an innovative and exciting vehicle through which students were encouraged to apply and integrate various mathematical concepts. When asked about students' problems with the software, these teachers discussed students' unfamiliarity with particular mathematical terms and concepts.

For other teachers, the software was seen very differently. Interestingly, computer and mathematics experience per se did not guarantee a match of the teacher's interpretation with the designers' intention. One math teacher who had taught computer programming interpreted the software as "a game about boats and navigation" which, after its initial introduction, should be reserved for before- and after-school hours or during free periods. Another teacher perceived children's problems with the software as due to their unfamiliarity with navigation, and the fact that many had never been on a boat before. For these teachers, navigation was seen as the central content, rather than as a context in which to introduce mathematics.

The simulation, unlike the computer and mathematics experiences commonly found in schools, was open to multiple interpretations. It could be relegated to the status of a game about boats or seen as an innovative context for teaching and learning mathematics.

The legitimacy of software. When teachers attempt to incorporate computer-based activities into their classrooms, they must consider whether the software is recognizable as curriculum or relevant to curricular goals, and whether it is legitimate. These are not independent considerations. For example, the teachers who interpreted

the navigation simulation as a game about boats decided it was not a legitimate part of the classroom curriculum. Much innovative software raises the question of legitimacy, precisely because it does not fit neatly and easily into established curricular niches.

One widespread method for dealing with the legitimacy problem is through "computer literacy." Almost any computer-based activity can be justified as promoting such literacy, as long as literacy is defined very broadly (e.g., feeling comfortable with computers; learning what kinds of things computers can do). While computer literacy may be a route through which many innovative ideas come into schools, it is not clear that this route will lead to substantive changes. As the database management example illustrated, through computer literacy teachers can avoid struggling with how to make the computer a learning tool that can function in different parts of the curriculum. As a separate topic, it can remain vague and unconnected.

Programming is sometimes thought of as computer literacy par excellence. For this reason, it has legitimacy as a separate curricular subject in many schools. In a two-year study conducted in Bank Street classrooms, we were interested in how the programming language Logo was assimilated into an elementary and middle-school classroom by teachers and students. The issues of what Logo was for, and whether or not it was legitimate, were primary ones for the classroom teachers over the two years (for further discussion, see Hawkins, 1984b). Teachers went through a lengthy process of revising their viewpoints about what Logo was good for, and how they could support this learning:

> I have a clear idea of culture such as it is, past culture, of what it means to be an educated person in terms of all different subject areas. In terms of the computer, it's not part of our culture really yet, it's something new so I don't have clear ideas of what kids should or should not know. (Sixth grade teacher)
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> There were kids who were losing interest. They were receiving a double message. I wanted computers to be a part of their work, yet it was optional. Kids would reach a problem in their work and they would be less inclined to push through it in the way they might with other work because I didn't make them....Few kids thought about it as a subject like others. They weren't tested in programming, and they know they have tests in other subjects. So when things weren't organized that way, kids dropped out. (Fourth grade teacher)

Throughout the two years, both teachers and students struggled with whether the programming work was legitimate as a classroom subject, and what learners should be held accountable for. Teachers began with the belief that children would learn general problem-solving skills and "powerful ideas" through self-guided learning with Logo (cf. Papert, 1980). Gradually, however, they began to recognize that children's learning was very local, and required considerable structured guidance from an expert to define and achieve programming goals. Thus, the teachers gradually revised their goals, expectations, and methods for incorporating Logo. The second year was characterized by clearer goals, more modest expectations about what students could achieve, and more structured methods for assuring that all students had experience with a given set of programming concepts. Questions of legitimacy--whether Logo was a topic in its own right, to be taken as seriously as other classroom subjects; whether or how it could expand students' skills in other areas--had not been clearly resolved by the end of the study.

Summary. Because computers are not one but many things as learning tools, it is necessary to investigate the meanings of the innovation for teachers and students in the process of asking questions about change. Studies of classrooms using computers in a variety of ways reveal that teachers grapple with the issue of its legitimate relationship to the traditional learning agenda. The occurrence of this interpretative work by teachers and students is one important aspect of the impact of technology on learning settings, and it defines the context in which other social changes might occur.

## Organization of Interactions

When attempting to understand the process of incorporating microcomputers into the work of classrooms, it is important to look at the kinds of interactions that take place. Just as computer technology can challenge traditional classroom curricula, it can also challenge the organization of learning interactions in classrooms. From the early introduction of microcomputers to classrooms, people noticed that learning interactions in many classrooms were different around the microcomputers (Levin & Kareev, 1980; Sheingold et al., 1983). When working with computers, students appeared to be interacting more with each other about learning tasks, and calling on each other more for help.

As participants in schools for some years, students and teachers understand the various ways in which information is presented and work gets done (e.g., large- and small-group activities, individual and collaborative work, discussion, homework, and tests). Students as young as eight are sensitive to the occasions in which different

forms of learning are appropriate (Hawkins 1984b). For example, from interviews with young students, we found that they had clear ideas about when collaborative work was appropriate and when individual work should be done. Overall, collaborative work was good for particular subject areas (e.g., doing a play, artwork,, when you wanted to have fun, or when you ran into a problem. Individual effort was better for "serious" work like math, research, tests, or when you wanted something done efficiently.

The presence of microcomputers can disrupt the framework for the social organization of work in interesting ways. Some of our research suggests that the presence of microcomputers can facilitate both collaborative interaction among students about their work, and increased opportunities for students to act as expert resources for other students. Neither of these forms of interaction occurs often in most classrooms. In our classroom programming study, we observed more collaboration among students, more solicitation of help from other students, and more "dropping in" to make comments or suggestions, with programming than with noncomputer activities in which students were permitted and/or encouraged to work together (Hawkins, Sheingold, Gearhart, & Berger, 1982). The presence of computers in classrooms may be accompanied by increasing salience of interactions among small groups and pairs of learners. These forms of interaction may be uncomfortable for many teachers who are accustomed to students working individually or as a whole class. Many teachers as well as students are unsure about the value of collaborative work for legitimate learning (Hawkins, 1984a). Working together may be fun and may teach social skills, but how does individual learning of content material take place? And, if it does, how does the teacher know it has taken place when the products of such joint activity are themselves collaborative?

The potential for emphasizing particular kinds of learning interactions, such as collaboration, raises issues for students as well as teachers. Students have well-developed expectations for what kinds of work they should be doing. They do not necessarily possess good collaborative skills for jointly solving problems (Hawkins, 1984), nor are they necessarily skilled at making use of human resources other than teachers in their work. One collaborative arrangement that was adopted by two girls in jointly writing a Logo program was: "I'm the thinkist, you're the typist." While this got the work done, it was not a particularly good way of incorporating each other's skills, nor was it an effective interaction for learning. One girl directed, the other typed. There was little exchange of information or argument that would lead either participant to consider alternative courses of action or to recognize misconceptions. The presence of computers may invite new learning interactions, but these must be valued and

supported by the overall learning environment in order for important changes to take place in the long run.

Traditional classroom organization positions a single adult as an expert resource for a large group of novices. The presence of microcomputers with challenging software may support the development of a pool of child experts. We have observed that individual students can develop considerable expertise in a particular area--in this case, aspects of programming in Logo. These students may be more knowledgeable than their teachers, and thus become sources of information for other members of the class. Since it is necessary for most teachers to acquire new skills in order to work with the machines in their classrooms, many are not far ahead of their students. While some teachers are comfortable with the restructuring of expertise in which students can take on some of the burden of instruction, some are not. However, this widely noted phenomenon may be temporary. As the computer becomes a more familiar presence, expertise structures will likely resume traditional patterns in many classrooms.

Thus, in addition to raising questions about the legitimacy of computer work in relation to curriculum, the presence of computers raises questions about the legitimacy of the teaching and learning interactions that they seem to afford. While generally valued, collaborative work among students and distributed expertise in classrooms are not always comfortable forms of interaction.

One popular way of dealing with these issues of legitimacy is to remove computers from classrooms and place them in resource rooms. Computer resource rooms are parallel to computer literacy in that they make possible the presence of computers without challenging either the traditional curriculum or forms of interaction in the classroom. Computers in resource rooms then become objects to be used and learned about in structured times and places, but they cannot then function as tools to enhance ongoing classroom learning. While resource rooms are generally adopted explicitly to address resource limitations and security issues, the strategy has the implicit consequence of reducing pressures to incorporate computers with their potential for change into the classroom.

## Conclusion

We are at the beginning of understanding the ways in which computer technology will have an impact on the social life of classrooms. As computers become a pervasive tool throughout our culture, their presence in schools offers interesting opportunities to teachers and students to learn new things about and through the technology. But, perhaps more importantly, they also offer the option of rethink-

ing the selection of learning agendas, the design of curricula, and the ways in which learning tasks are done in classrooms. At this early stage of research about technology in the social life of classrooms, we believe that it is important not simply to look for effects, but for the processes which will shape changes over the next few years.

We have observed that teachers interpret computer materials, and integrate the possibilities that these new tools offer into the framework they have organized for getting the year's work done. In the best of circumstances, the availability of computers with high-quality software can facilitate and extend the work of classrooms, and can support teachers in examining the ways in which they organize students' learning. For example, we know of one teacher who introduced a word processor into her writing curriculum. At the first level, the tool made it easier and more interesting for some children to engage in the writing process. The teacher reported that the children wrote more and, in some instances, participated in new kinds of collaborative writing with other children and with the teacher. Writing--usually a private affair and only shared after a draft is completed--could be made much more public. At a deeper level, the teacher, who had always given high priority to writing, began to rethink her writing curriculum and to formulate a new one that could be shared with other teachers. She designed a curriculum that emphasized the process of creating a polished text rather than the products that were created. The technology enabled her to require review, feedback, and revisions by students of their own and other students' work. The presence of the technology extended the traditional activity of writing in new ways, and supported the teacher in considering major changes in the way this curriculum area was taught.

Thus, we have observed that the technology is not simply a new educational device whose effects on classroom life can be readily measured. Rather, it can provoke teachers (in greater and lesser degrees) to think about issues of legitimacy of work, and the types of learning interactions that occur in their classrooms. Whether this "provocation" will result in visible changes in how learning occurs in classrooms is not yet clear. What <u>is</u> clear is that the use of computers in classrooms provokes us, as researchers, to look anew at the processes of change in the culture of the classroom.

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